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(71) [Applicant]
[ID Number] 592152255
[Name] Hayashi Kenji
[Address] Room 435, Bridgestone Kashio Seinen Kaikan, 150-7 Kashio-chō, Totsuka-ku, Yokohama-shi, Kanagawa-ken
(72) [Inventor]
[Name] Hayashi Kenji
[Address] Room 435, Bridgestone Kashio Seinen Kaikan, 150-7 Kashio-chō, Totsuka-ku, Yokohama-shi, Kanagawa-ken
(74) [Agent]
[Patent Attorney]
[Name] Yoshimura Hirofumi

(57) [Abstract]
[Object] To provide a floating structure wherein it is possible to reduce the number of buoyant bodies used, and to minimize the effect on the base of rocking etc. due to waves, and which is lightweight, can be assembled and installed on site, and is effective as a floating bridge, floating island, or other overwater structure.
[Constitution] It comprises a floating structure such as a floating bridge, with a floating body provided under a base, wherein said floating body is formed from a trussed-frame structure in which multiple frames are connected and assembled by joints in multi-angular directions, and the diagonal frames of said trussed-frame structure are formed of buoyant bodies.

[Claims]
[Claim 1] A floating structure, characterized in that in a floating structure such as a floating bridge, with a floating body provided under a base, said floating body is formed from a trussed-frame structure wherein multiple frames are connected and assembled by joints in multi-angular directions, and the diagonal frames of said trussed-frame structure are formed of buoyant bodies.
[Claim 2] A floating structure as described in Claim 1, wherein the frames of the trussed-frame structure are formed of FRP pipes, and buoyant bodies with conical ends are fitted around and mounted on those FRP pipes which form the diagonal frames amongst said frames.
[Claim 3] A floating structure as described in Claim 1, wherein the interior angle formed by neighbouring diagonal frames is between 45° and 90°.

[Detailed Description of the Invention]
[0001]
[Field of Industrial Application] The present invention relates to floating structures, and more specifically, to floating structures that are lightweight, can be assembled and installed on site, and are effective as floating bridges, floating islands, or other overwater structures having functions as floating breakwaters that reduce the effect of waves, or functions as fishing reefs.
[0002]
[Prior Art] Items with various configurations have previously existed as floating structures for floating bridges etc., with the basic structure configured so that a floating body is provided below a base and said floating body is used to make the base float above the water surface. Further,

items constituted by connecting together multiple small buoyant bodies, for example buoyant bodies comprising hollow bodies filled internally with air, have often been used for said floating body.
[0003] Furthermore, in order to be able to make these floating structures exert sufficient buoyancy, and moreover to minimize the effect of external turbulence from waves etc., designs were devised for example to make the mode of connection a flexible coupling, or the shape of the bottom surface of the buoyant body was for example rounded (see for instance Tokkai H1-273783, Tokkai H1-244011, Tokkai S62-34895 and the like). Also, this type of floating structure has a simple constitution, is therefore easy to install on water, and is used for various types of floating bridge or floating island, etc.
[0004]
[Problems to be solved by the invention] However, the traditional form of floating structure described above has a constitution wherein the buoyant bodies are connected only in the horizontal direction, and therefore the following types of problem arise.① No breakwater effect can be anticipated for irregular waves; ② Many buoyant bodies are required in order to reduce rocking of the base; and similar problems.
[0005] The present invention was created in response to problems such as those above, and aims to provide a floating structure wherein it is possible to reduce the number of buoyant bodies used, and to minimize the effect on the base of rocking etc. due to waves, and which is lightweight, can be assembled and installed on site, and is effective as a floating bridge, floating island, or other overwater structure.
[0006]
[Means to solve the problems] So, a floating structure as a means to solve the aforementioned problems comprises a floating structure such as a floating bridge, with a floating body provided under a base, wherein said floating body is formed from a trussed-frame structure in which multiple frames are connected and assembled by joints in multi-angular directions, and the diagonal frames of said trussed-frame structure are formed of buoyant bodies.
[0007] Further, other floating structures of the present invention are composed of the aforementioned invention, wherein the frames of the trussed-frame structure are formed of FRP pipes, and buoyant bodies with conical ends are fitted around and mounted on those FRP pipes which form the diagonal frames amongst said frames, and where the interior angle formed by neighbouring diagonal frames is between 45° and 90°.
[0008]
[Operation] In the floating structure of the present invention based on the aforementioned constitution, a floating body is formed in a trussed-frame structure and the diagonal frames of said trussed-frame structure are formed of buoyant bodies, so the structure thereof is stable and also operates in such a way that it is possible to form a floating body with few buoyant bodies. Further, it is possible to form multiple spaces with polygonal pyramid shapes between neighbouring buoyant bodies and the base, and between neighbouring buoyant bodies and the bottom surface, so a breakwater effect is obtained; the effect on the base of rocking due to waves etc. can be minimized, and said spaces operate so as to form fishing reefs.
[0009] Also, when constituted so that buoyant bodies with conical ends are fitted around and mounted on those FRP pipes which form the diagonal frames amongst the frames, it operates in such a way at the installation site that the buoyant bodies can be reinforced and connection to the joints can be performed easily.
[0010] As above, the floating structure of the present invention has the characteristics that ① the floating body forms a trussed-frame structure, and ② the diagonal frames of the trussed-frame structure are formed from buoyant bodies; through these features, it is possible to reduce the number of buoyant bodies used, and minimize the effect on the base of rocking etc. due to waves, and to perform excellent operation, in that it is lightweight and can be assembled and installed on site.
[0011]
[Embodiments] Next some embodiments which embody the present invention will be explained, with reference to the drawings. Here, Figs. 1-8 show one embodiment of the present invention; Fig. 1 is a perspective view, Fig. 2 is a plan view of the floating body, Fig. 3 is a side view, Fig. 4

is a front view of the buoyant bodies, Fig. 5 is a side view of the buoyant bodies, Fig. 6 is a perspective view of the base, Fig. 7 shows the joints, Fig. 7(a) is a plan view, Fig. 7(b) is a front view, Fig. 7(c) is a sectional view across A-A, Fig. 7(d) is a sectional view across B-B, Fig. 7(e) is a sectional view across C-C, Fig. 8 shows the joint part in a state with buoyant bodies connected, Fig. 8(a) is a plan view, Fig. 8(b) is a front view.

[0012] The floating structure of the present embodiment is an embodiment which embodies the invention as a floating bridge, and in short is constituted by a base 1 under which a floating body 2 comprising a trussed-frame structure (space-frame structure) is provided.

[0013] The base 1 is beams or a bridge deck constituting the floating bridge, and in the case of the present invention is formed from multiple bearing bars 3, 3... and tie-rods 4, 4... crossing at prescribed intervals. The bearing bars 3, 3... and tie-rods 4, 4... are formed from FRP. Normally, the pitch of the bearing bars 3, 3... would be around 50.8 mm and the hole width around 25.4 mm, while the pitch of the tie-rods 4, 4... would be around 310-1220 mm. Next, a floating body 2 is provided underneath the base 1. However, the base 1 could also be formed from plate-like bodies.

[0014] The floating body 2 is formed from a trussed-frame structure composed of multiple frames 5, 5... and joints 6, 6... The frames 5, 5... have three frames – upper main frames 7, 7..., lower main frames 8, 8..., and diagonal frames 9, 9... which are connecting frames – and each of these are made of FRP pipes, usually of 50.8 mm ø and length 1000 mm, using pipe bodies able to withstand 6.4 t.

[0015] The joints 6, 6... are joints connecting multiple frames 5, 5... to form the trussed-frame structure, formed from a cylindrical body whose upper part is a truncated conical shape, and constituted so that insertion holes 10, 10... for connecting the frames are opened in the peripheral wall of the truncated conical part 6a and the peripheral wall of the cylindrical part 6b. The joints 6, 6... are formed from plastics such as nylon resin (polyamide resin). Here, it is constituted so that 4 insertion holes 10 are opened in the peripheral wall of the truncated conical part 6a and 4 insertion holes 10, 10... are opened in the peripheral wall of the cylindrical part 6b, and made so that the frames 5, 5... (main frames 7 & 8 and diagonal frames 9) can be inserted and fixed in multi-angular directions (radially) with respect to the joint 6.

[0016] Further, amongst the multiple frames 5, 5..., the diagonal frames 9, 9... which are inserted into the peripheral wall of the truncated conical part 6a of the joints 6, 6... have buoyant bodies with conical ends 11, 11... fitted around and mounted on them. Here, the diagonal frames 9, 9... and the buoyant bodies with conical ends 11, 11... are normally fixed using adhesives. The buoyant bodies with conical ends 11, 11... are hollow bodies made of polyethylene resin, and frame insertion holes 10 are formed in said hollow bodies and the surface thereof is silicon-treated. Here, the angle of inclination (angle compared to the surface of the water) of the diagonal frames 9, 9... is set to 30-60° (the interior angle between neighbouring diagonal frames is 50-90°) and made equiangular.

[0017] With the floating bridge of the present embodiment based on the aforementioned constitution, the bearing bars 3, 3... and tie-rods 4, 4... which form the base 1, the frames 5, 5..., joints 6, 6..., and the diagonal frames 9, 9... inserted into buoyant bodies with conical ends 11, 11..., are manufactured in advance at a factory, and then installed and applied by assembling them on site. In other words, on-site installation is performed by crossing and assembling the bearing bars 3, 3... and tie-rods 4, 4... at specified intervals to obtain the base 1, and obtaining a floating body for each unit from the joints 6, 6... and frames 5, 5... (main frames 7 & 8) and the buoyant bodies with conical ends 11, 11..., and connecting these to assemble the prescribed floating body 2, and fixing the base 1 to the upper main frames 7, 7... of said floating body 2.

[0018] Then, according to the floating bridge of the present invention, the floating body 2 is formed in a trussed-frame structure, and the connecting frames which form said trussed-frame structure are formed of buoyant bodies with conical ends 11, 11..., so the structure thereof is stable and also operates in such a way that it is possible to form a floating body 2 with few buoyant bodies 11, 11...

[0019] Further, it is possible to form multiple spaces with polygonal pyramid shapes between neighbouring buoyant bodies with conical ends 11, 11... and the base 1, and between neighbouring buoyant bodies with conical ends 11, 11... and the bottom surface (lower main frames 8, 8...), so a breakwater effect is obtained, the effect on the base of rocking due to waves etc. can be minimized, and said spaces operate so as to form fishing reefs.

[0020] Next, to check the effectiveness of the floating bridge in the present embodiment, this floating bridge was floated on the sea surface and subjected to durability and buoyancy tests, whereupon it was confirmed that sufficient durability and stability can be obtained. Further, in order to compare differences with the floating bridge of the present embodiment, it was compared with a constitution wherein the buoyant bodies (connecting frames) were arranged vertically, using the same type of materials as in the floating bridge of the present embodiment; with the present embodiment almost no effect of rocking due to waves could be perceived, but in the item where the buoyant bodies were arranged vertically, little breakwater effect could be perceived and large rocking was perceived due to the influence of the waves. From this fact we were able to confirm that giving the present embodiment a trussed-frame structure (space-frame structure) with the buoyant bodies arranged diagonally minimized the effect of rocking due to waves.
[0021] It should be noted that the present invention is not restricted to the embodiment described above, and includes constitutions that can be made with altered forms, provided that the essence of the present invention is not changed. Incidentally, the aforementioned embodiment was explained with a constitution wherein the buoyant bodies of 1 unit were formed as a frame in a reverse square pyramid shape, but it goes without saying that it is fine to constitute the frame as a triangular pyramid or other polygonal pyramid, and to have a constitution with multiple layers arranged in the up and down direction. Also, it is fine to have a constitution with buoyant bodies provided on the main frames.
[0022]
[Beneficial effects of the invention] As is apparent from the explanation above, the floating structure of the present invention has the beneficial effect that a floating body is formed from a trussed-frame structure and the diagonal frames of said trussed-frame structure are formed of buoyant bodies, so the structure thereof is stable and it is also possible to form a floating body with few buoyant bodies.
[0023] Further, the floating structure of the present invention also has the beneficial effect that it is possible to form multiple spaces with polygonal pyramid shapes between neighbouring buoyant bodies and the base, and between neighbouring buoyant bodies and the bottom surface, so a breakwater effect is obtained, the effect on the base of rocking due to waves etc. can be minimized, and said spaces can be made into fishing reefs.
[0024] Also, in the floating structure of the present invention, when constituted so that buoyant bodies with conical ends are fitted around and mounted on those FRP pipes which form the diagonal frames amongst the frames, it has the beneficial effect that at the installation site, the buoyant bodies can be reinforced and connection to the joints can be performed easily.
[0025] The present invention therefore has the beneficial effects that it is possible to reduce the number of buoyant bodies used, and to minimize the effect of rocking due to waves etc. on the base, and that it is lightweight and can provide a floating structure that is effective as a floating bridge which can be assembled and installed on site, a floating island, or other overwater structures.

[Brief Explanation of the Drawings]
[Fig. 1] is a perspective view of a floating bridge showing one embodiment of the present invention.
[Fig. 2] is a plan view of the floating body.
[Fig. 3] is a side view.
[Fig. 4] is a front view of a buoyant body.
[Fig. 5] is a side view of a buoyant body.
[Fig. 6] is a perspective view of the base.
[Fig. 7] shows the joints; Fig. 7(a) is a plan view, Fig. 7(b) is a front view, Fig. 7(c) is a sectional view across A-A, Fig. 7(d) is a sectional view across B-B, Fig. 7(e) is a sectional view across C-C.
[Fig. 8] shows the joint part in a state with buoyant bodies connected; Fig. 8(a) is a plan view, Fig. 8(b) is a front view.

[Key to Symbols]
1 = base, 2 = floating body, 3 = bearing bars, 4 = tie-rods, 5 = frames, 6 = joints, 6a = truncated conical part of joint, 6b = cylindrical part, 7 = upper main frame, 8 = lower main frame, 9 =

connecting frames (diagonal frames), 10 = insertion holes for connecting joints with frames, 11 = buoyant bodies with conical ends

[Fig. 1] [Fig. 2] [Fig. 5]
[Fig. 3] [Fig. 4]
[Fig. 6]

[Fig. 7] [Fig. 8]